The South African species of the *hirsuta*-group of the genus *Xenopsylla* Glinkiewicz (Siphonaptera : Pulicidae)

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During a revision of the slide-collection of Siphonaptera at the South African Institute for Medical Research, some problems arose about the identification of specimens of the *hirsuta*-group of *Xenopsylla* Glinkiewicz, 1907. By studying more extensive material (previously in alcohol) of most of the species concerned, it was possible to overcome some of the difficulties. Of the group, two excellent monographs are already available (Hopkins & Rotschild, 1953; de Meillon, Davis & Hardy, 1961). They were of the greatest assistance in preparing this paper and therefore descriptions could be less detailed, though the main features of each taxon are fully indicated.

The material studied belongs to the flea-collection of the South African Institute for Medical Research. Several specimens, including paratypes of the new taxa, have been deposited in the collection of the British Museum (Natural History) at Tring.

The members of the *hirsuta*-group*) are mainly distinguished from other species of *Xenopsylla* by the absence of a distinct suture between sternum and episternum of the metathorax, although usually traces of an internal ridge are visible and the vestige of the suture is indicated by the configuration of the fine surface sculpture.

Males may further be characterized as follows: Occipital groove continued onto pronotom and, at least in the species where it is deep, onto mesonotum. (A very shallow groove on mesonotum is not usually preserved in slide-mounted specimens). Tergum I with two rows of setae, those of the posterior row stronger than in most species of the genus and partially erect; they may form a dense group

*) The definition of the group and the statements on its distribution and host relationships refer to the South African species only. There is another species, *Xenopsylla petteri* Lumaret, 1962 (*Faune Madagascar* **15**: 50), found on *Hypogeomys antimena* A. Grandidier in Madagascar, which was not known to the author before this paper was given to press. Though certainly best placed in the *hirsuta*-group this species differs from all those treated here in many instances, to mention only a few in the male: antesensilial seta not marginal; P_1 of clasper relatively long; modified setae of st. VIII of different shape and placement; structure of the apex of the aedeagus not corresponding with the other species. To Dr Lumaret, Valence (Drome), sincere thanks are due for the gift of specimens of *X. petteri*.

and be placed on a separate, sclerotized lobe. Apical margin of t. I indentated mid-dorsally. Antesensilial seta*) on a more or less prominent cone. P_1 of clasper minute, with some small hairs, P_2 long, elliptical, narrow at its base. Sternum VIII with a subapical row of very long and stout setae (only one of these setae in *hirsuta placidia* de Meillon & Hardy). Median dorsal lobe of aedeagus (fig. 4, M.D. L.) often forming a digitoid projection, lateral lobes (L.L.) reinforced by a distinct sclerite (Scl.). Median lamella of aedeagal apodeme very narrow at the base, gradually broadening towards the apex which is strongly convex in all species except *davisi* de Meillon.

Female with numerous lateral setae on t. VIII extending far upwards. Bulga of spermatheca asymmetrical or subspherical, base of hilla not greatly swollen and less than half of hilla darkened.

Morphological and ecological evidence show a close relationship between *Xenopsylla hirsuta*, *lobengulai* de Meillon and *sulcata* Ingram on the one side and *Xenopsylla davisi* and *demeilloni* (described below) on the other. In order to avoid a repetition of many characters in the description of each species these two complexes are here considered as subgroups for practical purposes though they are closely related to one another.

The *hirsuta*-group is confined to the south-western part and the west coast of South Africa. The principal hosts are the gerbils *Tatera afra* (Gray) and *Gerbillus paeba* A. Smith.

Xenopsylla hirsuta can transmit plague in the laboratory [*Rep. S. Afr. Inst. med. Res.* **1929** (1930): 30]. It, and perhaps other species of this group as well, might be a vector of this disease, should plague spread into their area of distribution. So far only one rare species (*Xenopsylla sulcata*) occurs on the edge of the plague-enzootic area.

Key to males

1. The most dorsal of the lateral setae on st. VIII placed at least as far dorsally as the upper end of the subapical row. Median dorsal lobe of aedeagus (usually, but not always, forming a finger-like projection) and lateral lobes connected without a deep incision in between; lateral lobe reinforced by a sclerite up to the apical margin . . . . . (**hirsuta**-subgroup) 2

— Subapical row of setae on st. VIII extending far more dorsad than any of the lateral setae. A deep incision between the finger-like projecting median dorsal lobe and the lateral lobes of aedeagus; sclerite of lateral lobe not reaching the apical margin . . . . . (**davisi**-subgroup) 6

2. Median dorsal lobe of aedeagus short, not projecting (fig. 3). Apical margin of st. VIII produced dorsally into a large triangular prominence; setae in the subapical row very long and stout, all of about equal length, the more ventral of them strongly bent (fig. 10). T. I. with numerous strong setae placed on a conspicuous prominence (fig. 19). . . . . **sulcata**

— Median dorsal lobe of aedeagus forming a long digitoid projection. Apical margin of st. VIII without a dorsal prominence; setae in the subapical row either few *or*, if they are more numerous, their length gradually increasing from the uppermost seta to the more ventral 3

*) Usually only the single large antesensilial seta is described in *Xenopsylla*, ignoring the two minute dorsal and ventral ones and this convention is also accepted here.

3. Posterior row on each side of t. I composed of four partially erect setae. One to eight long stout setae in the subapical row of st. VIII, the more ventral of them at most slightly bent. 4

— Semi-erect setae in the posterior row of T.I. usually numerous, on each side forming a dense group placed on a sclerotized prominence. Long setae in the subapical row of st. VIII numerous (7-13) the more ventral of them with a kink or a distinct bend at about midlength 5

4. Subapical row of st. VIII with four to eight, usually five or six setae (fig. 6). . . . . **hirsuta hirsuta**

— Subapical row of st. VIII with only one or two stout setae (fig. 7) . . **hirsuta placidia**

5. Antesensilial seta on a prominent cone (fig. 8). Apical margin of lateral lobes at about a right angle to the anterodorsal surface of aedeagus (fig. 1). Some of the more ventral setae in the subapical row of st. VIII distinctly bent (fig. 8) **hirsuta multisetosa**

— Pedestal of antesensilial seta short, rounded and inconspicuous (fig. 9). Apical margin of lateral lobes at a sharp angle to the anterodorsal surface of aedeagus (fig. 2). Some of the more ventral setae in the subapical row of st. VIII with a kink at about the middle (fig. 9) . . . . . **lobengulai**

6. Subapical row of st. VIII consisting of 9-12 long, stout, straight setae. Distal arm of st. IX expanded below the middle. Antesensilial seta placed on a prominent pedestal (fig. 11). Median lamella of aedeagal apodeme narrow, pointed dorso-apically; sclerite of lateral lobe of aedeagus widened towards its posteroventral end (fig. 4) . . . . . **davisi**

— About five moderately stout and long, straight setae in the subapical row of st. VIII. Distal arm of st. IX of about equal width throughout. Pedestal of antesensilial seta not prominent (fig. 12). Median lamella broadly rounded apically; sclerite of lateral lobe of aedeagus of about equal width throughout (fig. 5) . . . . . **demeilloni**

Key to females

1. Basal sternum of abdomen with one to three lateral setae each side. Sclerotization in the wall of the duct of bursa copulatrix long and narrow (figs., 13, 14) (**hirsuta**-subgroup) . . . . . **hirsuta, lobengulai** and **sulcata**

— Basal sternum of abdomen without lateral setae. Sclerotization in the wall of the duct of bursa copulatrix shorter . . . . . (**davisi**-subgroup) 2

2. Bulga of spermatheca usually subglobular. Sclerotization of duct of bursa copulatrix broad and bowed (fig. 15) . . . . . **davisi**

— Bulga of spermatheca usually asymmetrical. Sclerotization of duct of bursa copulatrix narrower, nearly straight (fig. 16) . . . . . **demeilloni**

THE *hirsuta*-SUBGROUP

MALE: Median dorsal lobe of aedeagus connected with the lateral lobes without a deep incision in between; sclerites of lateral lobes extending up to the apical margin of the lobes. Median lamella of aedeagal apodeme broadly rounded apically. Subapical row of setae on st. VIII extending at most as far upwards as the most dorsal of the lateral setae; where they are numerous (about six and more) some of the setae in this subapical row are more or less bent in about midlength. Long seta on t.IX mounted on a distinctive pedestal. Apical margin of t.I in its upper part with a fringe of minute hair-like outgrowths (figs. 17-19).

FEMALE: (figs. 13, 14): Basal sternum of abdomen (st.II) bears one to three lateral setae each side in addition to the pair of ventral setae present in all members of the group*). Duct of bursa copulatrix long, the sclerotization of its wall long and narrow. Shape of spermatheca very variable; bulga in *hirsuta* and *lobengulai* often still more asymmetrical than shown in fig. 13 and hilla relatively narrow, but at least in *hirsuta* bulga often subglobular and hilla thick (fig. 14) a pattern still more frequently found in *sulcata*. This great variability makes it impossible to separate females of this subgroup on morphological evidence alone and their accurate identification is only possible through consideration of geographical distribution (figs. 21, 22) and reference made to the males taken together with them.

The only true host of the species of this subgroup seems to be *Tatera afra* (Gray), where they were found on the body as well as in burrows and nests. Their distribution coincides very well with that of the host, i.e. the winter rainfall area of the south-western Cape Province including the Robertson Karoo (*lobengulai*) and parts of the north-western Karoo mountains (*sulcata*). The species and subspecies are mainly allopatric, only the ranges of *sulcata* and *hirsuta multisetosa* seem to overlap in the region of Citrusdal (see under *X. hirsuta multisetosa*).

Xenopsylla hirsuta hirsuta Ingram, figs. 6, 17 and 21

Xenopsylla hirsuta Ingram, 1928, *Bull. ent. Res.* **18**: 372, figs. 4B, 5, 6A (Belleville, C. P., from nests of *Tatera afer*). - De Meillon, 1930, *Novit. zool.* **36**: 139-42, figs. 2, 7.

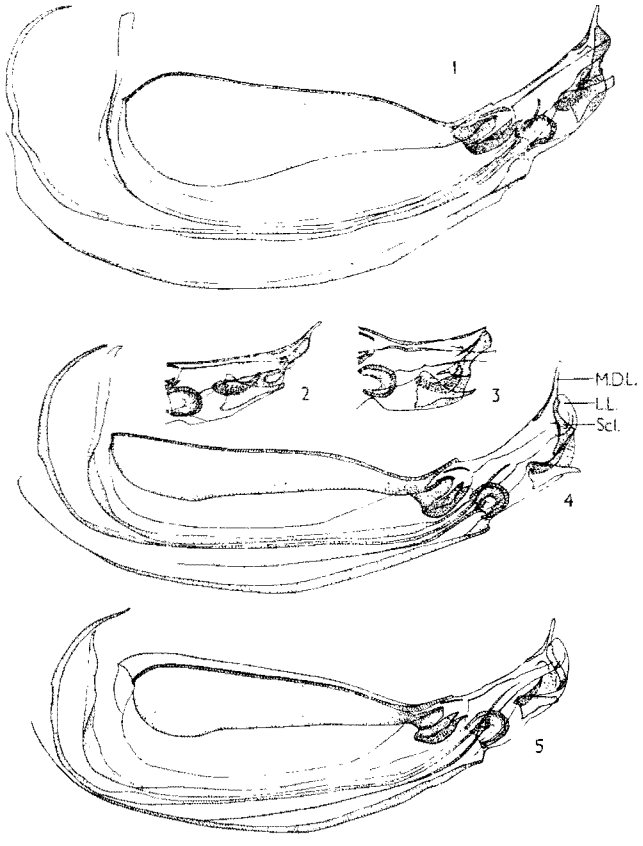
Xenopsylla hirsuta hirsuta; Hopkins & Rothschild, 1953, Ill. Cat. Roths. Coll. Fleas **1**: 351, figs. 447, 454, 455, 457, pl. 43G; De Meillon, Davis & Hardy, 1961, Plague in Southern Africa **1**, The Siphonaptera: 139, pl. 26: 1-3.

Males are distinghuised from other species by the configuration of the apex of phallosome and from the other subspecies of *hirsuta* by number, shape and arrangement of the setae in the subapical row of st. VIII, moreover, from *hirsuta multisetosa* (and *lobengulai* and *sulcata* as well) by the lack of a separate hump on t.I, the setae in its posterior row placed on the plain surface. Females are inseparable from the other subspecies and from *lobengulai* and *sulcata* as well.

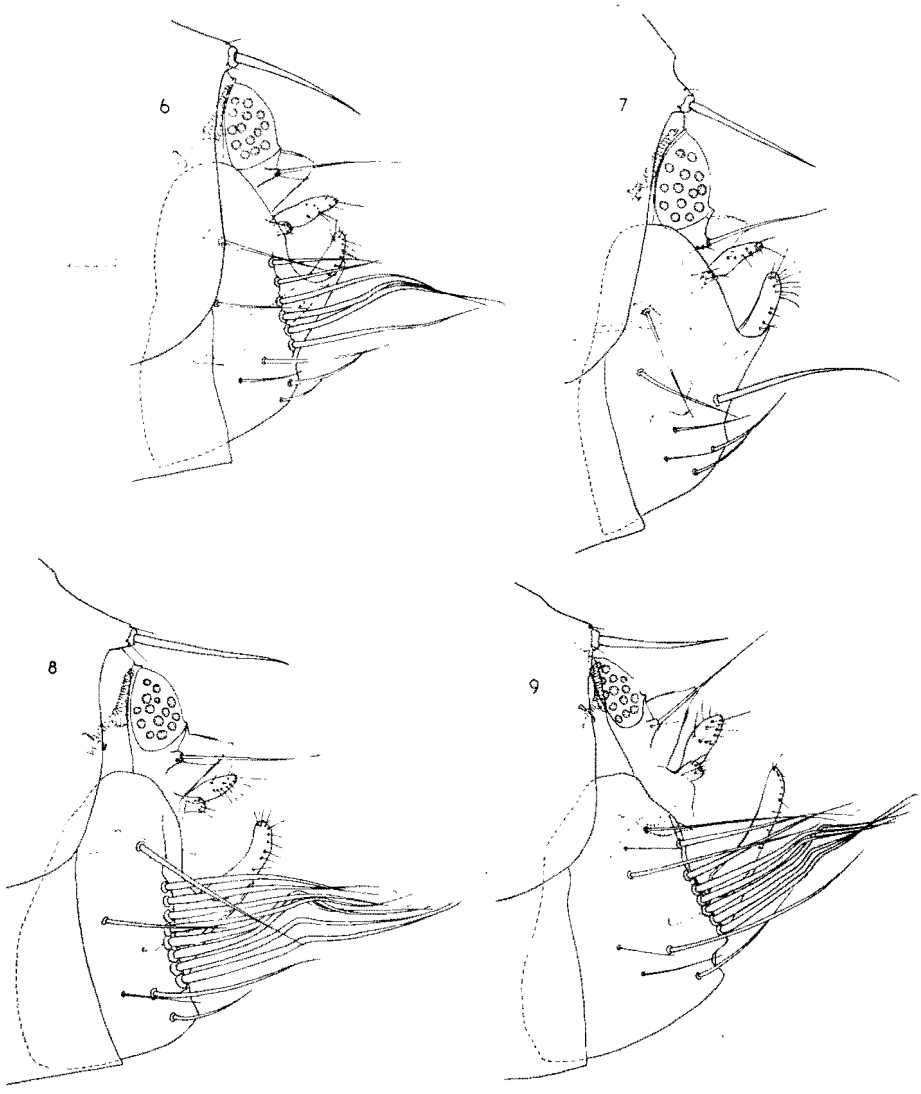
MALE: Greatest depth of occipital groove at most equal to greatest depth of eye, generally distinctly less. T.I. with two to four small setae in the anterior row and 4 stronger partially erect ones in the posterior row on each side, the latter not placed on any conspicuous prominence; apical margin of t.I fringed only in proximity of its relatively shallow mediodorsal excavation (fig. 17, where the tergum is expanded; in lateral view its shape is similar to that of *demeilloni*, cf. fig. 20. In Hopkins and Rothschild, 1953, fig. 455, the posterior, weakly sclerotized parts of t.I are not drawn and the same applies to fig. 456 of *sulcata*.). Antesensilial

*) Only very exceptionally are the lateral setae absent, as in two females („Aurora-Velddrif area", Piketberg dist. and „3.2 miles from Vredenburg on road to Saldanha Bay", Malmesbury Distr.) found together with males of *h. hirsuta* and therefore probably belonging to this subspecies too.

seta placed on a short, but distinct pedestal. Four to eight, usually five or six stout setae each side in the subapical row of st. VIII, their length gradually increasing from the wider spaced more dorsal setae to the more ventral ones, which are often slightly bent in about mid-length. About four to five long and two or more smaller lateral setae on each side of st. VIII (fig. 6). Distal arm of st. IX of about equal width throughout. Median dorsal lobe of aedeagus forming a finger-like projection. Apical margin of lateral lobes at about a right angle to the antero-dorsal surface of aedeagus; the sclerites of lateral lobes broad, somewhat narrowed in the middle, reaching the apical margin of the lobes. Median lamella of aedeagal apodeme as



Figs. 1-5. Phallosome of 1. *Xenopsylla hirsuta multisetosa* subsp. nov., paratype; aedeagus of 2. *X. lobengulai* de Meillon, paratype, Chavonnes, and 3. *X. sulcata* Ingram; phallosome of 4. *X. davisi* de Meillon, and 5. *X. demeilloni* spec. nov., paratype. - (M. D. L. = Median dorsal lobe of aedeagus; L. L. = Lateral lobe of aedeagus; Scl. = Sclerite of lateral lobe of aedeagus).



Figs. 6-9. Terminal segments of male (phallosome omitted) of 6. *Xenopsylla h. hirsuta* Ingram; 7. *X. hirsuta placidia* de Meillon and Hardy, holotype; 8. *X. hirsuta multisetosa* subsp. nov., holotype, and 9. *X. lobengulai* de Meillon.

in other species of the subgroup, broadening gradually towards the strongly convex apex (fig. 1, drawn from *hirsuta multisetosa*; the phallosome is identical in the different subspecies of *hirsuta*).

Specimens seen: 164♂♂ and 203♀♀ on slides and 100♂♂ and 217♀♀ in alcohol.

This subspecies is distributed in the south-western Cape Province between the west coast and the continuous mountain chains from Somerset West in the South, where it is separated from *hirsuta placidia* by the Hottentots Holland mountain range to about Elandsbaai in the north. In the more southern range of its distribution it extends rather far inland and even into mountainous country (Prince Alfred's Hamlet, Ceres Distr.) but farther north it is confined to the regions near the coast and is replaced inland. Most of the material comes from *Tatera afra* (Gray), the principal host, 43♂♂ and 15♀♀ were taken on *Parotomys brantsi* A. Smith and a few occasional specimens on *Gerbillus paeba* A. Smith, *Otomys unisulcatus* Cuvier, *O. irroratus* (Brants) and *Rhabdomys pumilio* (Sparrman).

Xenopsylla hirsuta placidia de Meillon and Hardy, figs. 7 and 21

Xenopsylla hirsuta placidia de Meillon and Hardy, 1951, *J. ent. Soc. S. Afr.* **14**: 33 (3.6 miles from Stanford on road to Gansbaai (C. P.) from nest of *Tatera* species; Hopkins & Rothschild, 1953, Ill. Cat. Roths. Coll. Fleas **1**: 352, fig. 448, pl. 45D; De Meillon, Davis & Hardy, 1961, Plague in Southern Africa **1**, The Siphonaptera: 140, pl. 26: 4.

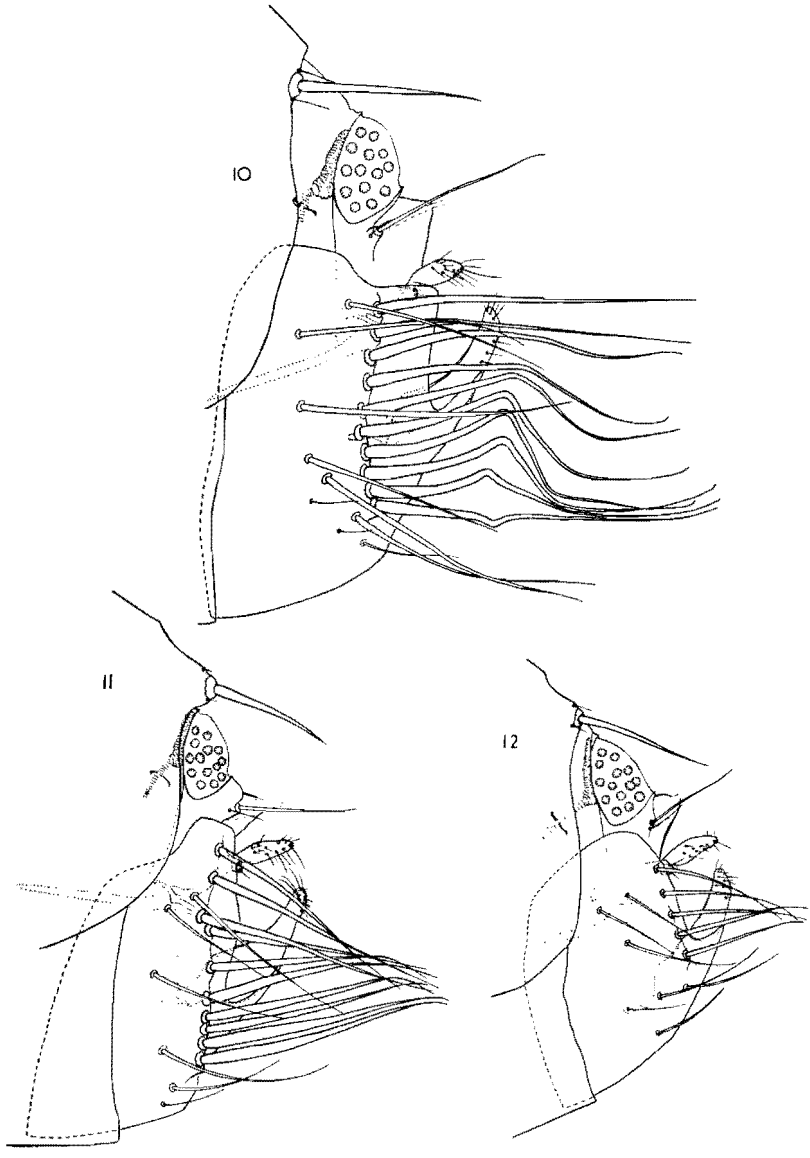
This subspecies is similar in all respects to *h. hirsuta*, except that st.VIII of male bears only one or two strong setae each side (fig. 7) instead of a much longer row of such setae in all other members of the *hirsuta* group. The occipital groove in male is also shallower than in *h. hirsuta*, its greatest depth hardly equal to half the greatest depth of eye. Females are inseparable from those of the other forms of the *hirsuta* subgroup.

Specimens seen: ♂ - holotype and three ♂ -, one ♀ - paratypes, 3.6 miles from Stanford on road to Gansbaai (C.P.) from *Tatera* (*afra*) nest, 17.I.1950, C.V. Muller.

Xenopsylla hirsuta multisetosa subsp. nov., figs. 1, 8, 13, 14, 18 and 21

Males of this subspecies greatly resemble *lobengulai*, but are separated by the structure of the apical portion of aedeagus, by the much longer pedestals of the antesensilial setae, which are more prominent than in all other members of the *hirsuta* group and by the setae in the subapical row of st.VIII which are usually more strongly bent. Females (figs. 13, 14) cannot be separated from other members of the *hirsuta* subgroup.

MALE: Occipital groove deep, its greatest depth equal to greatest depth of eye or sometimes even deeper. T.I. with about two small setae each side in the anterior row and five to ten, mostly eight or nine, stronger semi-erect setae, forming a dense group placed on a sclerotized prominence in the posterior row; apical margin of t.I deeply indentated medio-dorsally, cutting the posterior part of the



Figs. 10-12. Terminal segments of male (phallosome omitted of 10. *Xenopsylla sulcata* Ingram. 11. *Xenopsylla davisi* de Meillon, holotype, and 12. *X. demeilloni* spec. nov., holotype.

tergum into two blunt lobes which are extensively fringed with minute false hairs, the postero-ventral angle of t.I indicated by a weakly developed, rounded prominence (fig. 18). Antesensilial seta mounted on a conspicuous pedestal which is about as long as broad. (Six to) Seven to 11, usually eight or nine stout setae in the subapical row of st. VIII, their length gradually increasing from the nearly straight dorsal ones to the more ventral setae which are distinctly bent in about midlength. Some small and four to five long lateral setae on st.VIII (fig. 8). Distal arm of st. IX and phallosome (fig. 1) as in *h. hirsuta*.

♂ - Holotype: east of Het Kruis and north of Belt (C.P.) from *Tatera afra*, 18. XI. 1942, C.V. Muller. 174♂ - Paratypes: on slides, from numerous localities around Het Kruis and Eendekuil, from „Piketberg to Aurora area", The Rest, Citrusdal and Paleisheuvel. In addition 110♀♀ on slides and about 225♂♂ and 430♀♀ in alcohol were studied.

On the distribution-map of *X. lobengulai* in de Meillon, *et al.* (1961, map 19D) all records north of 33° S are to be referred to as *hirsuta multisetosa*.

This subspecies which was found exclusively on *Tatera afra* (Gray) is the northern inland form of *hirsuta*, approaching only on the northern end of its distributional range the west coast of South Africa. Where it meets with *h. hirsuta*, intergrades occur. They were found especially in the northern portion of the boundary between the two subspecies (Redelinghuis; 22 and 24 miles north of Het Kruis; Sandberg; Leipoldtville; 7 miles east of Lamberts Bay, altogether 24♂♂ and 47♀♀ found with them). In many of these males, the number of the setae are in the subapical row of st.VIII is reduced (sometimes only five on each side) and they are less strongly bent than is usual in *multisetosa*. In others these are setae very similar to typical *multisetosa*, but the pedestal of the antesensilial seta is approximately as short as in *h. hirsuta*. In nearly all specimens, however, the sclerotized prominences of t.I are much reduced and often inconspicuous, bearing much less setae (four to six) than is usual in *multisetosa*. These specimens were labelled only *Xenopsylla hirsuta*, without indication of a subspecies.

On the other hand specimens from Citrusdal (eight♂♂, in two of them especially marked, these therefore not labelled as paratypes) the setae on st.VIII and the prominences of t.I are much more strongly developed, approaching *sulcata* in this respect. But the conspicuous pedestal of antesensilial seta and the shape of apex of phallosome (although the median dorsal lobe of aedeagus is occasionally somewhat shorter projecting than usual) allow these specimens to be associated with *multisetosa*. Unfortunately the fact that all material obtained from Citrusdal is composite, collected from several host specimens, renders it impossible to state if both species occur together on the same animal or even at the same spot.

Xenopsylla lobengulai de Meillon, figs. 2, 9 and 22

Xenopsylla lobengulae de Meillon, 1930, *Novit. zool.* **36**: 139, figs. 1, 3, 5, 8-10 (Chavonnes, Worcester, C. P. from *Tatera lobengulae* - recte *T. afra*); De Meillon, 1940, *Proc. R. ent. Soc. London* (*B*) **9**: 151.

Xenopsylla lobengulai; Hopkins & Rothschild, 1953, Ill. Cat. Roths. Coll. Fleas **1**: 353, figs. 450, 452, 461-464, pl. 43H; De Meillon, Davis & Hardy, 1961, Plague in Southern Africa **1**, The Siphonaptera: 140, pl. 26: 5-7.

The males of this species are easily distinguished by the shape of the apex of aedeagus (fig. 2), and from all other species except *hirsuta multisetosa* and *sulcata* by the chaetotaxy of t.I and st.VIII (fig. 9). Females cannot be separated from *hirsuta* and sometimes even from *sulcata* by morphological evidence alone.

MALE: Greatest depth of occipital groove usually about equal to greatest depth of eye. On t.I generally only one small seta each side in the anterior row and about 10 stronger, semi-erect ones in the posterior row, these mounted onto a prominent sclerotic lobe similar to *hirsuta multisetosa* and *sulcata*, but not quite so strongly developed as in the latter; posterior part of the tergum similarly shaped as in *hirsuta multisetosa* but the posteroventral angle completely rounded as in *sulcata*. Antesensilial seta placed on a low, rounded prominence. St. VIII with four to five long and one to three smaller lateral setae and with a subapical row of (six to) seven to 10 long stout setae, the more ventral of them closely set and with a kink in about midlength, but the more dorsal straight, shorter and wider spaced (fig. 9). Distal arm of st.IX of about equal width throughout. Median dorsal lobe of aedeagus forming a long digitoid projection; lateral lobes narrow, strengthened by a long, slender sclerite which reaches the distal margin, this margin being at a sharp angle with the anterodorsal surface of aedeagus (fig. 2). Median lamella of aedeagal apodeme of the type usually found in this group, broadened gradually to a strongly convex apex.

In some specimens, more numerous in the south-eastern range of distribution of the species, the antesensilial seta is mounted on a slightly more prominent pedestal and the sclerite of the lateral lobe of aedeagus is of nearly equal width throughout.

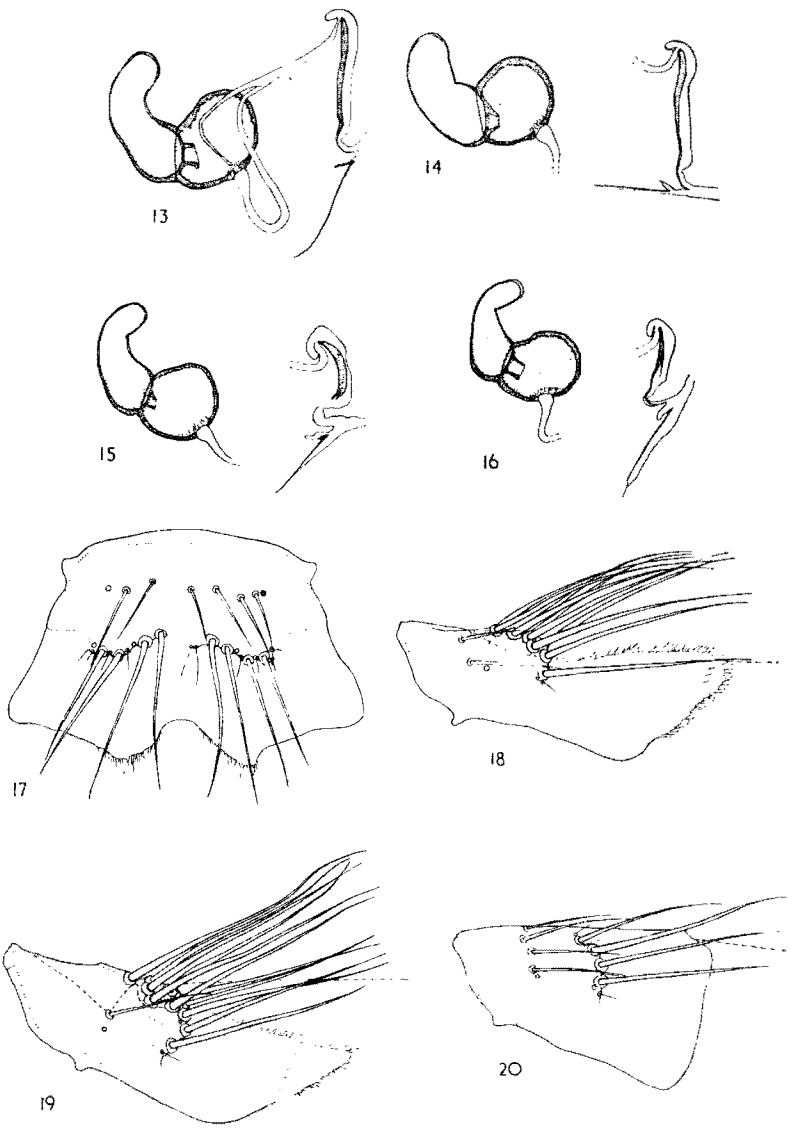
Specimens seen: 78♂♂ and 81♀♀ on slides (among them 19♂♂ and 14♀♀ paratypes from Chavonnes) and about 80♂♂ and 190♀♀ in alcohol.

This species was collected exclusively from *Tatera afra* (Gray) with the only exception of one record from *Rattus rattus* (Linné). It is the representative of the group in the western part of the south coast of South Africa as far north as the Langeberg mountains and as far east as Mossel Bay, where the range of its host is limited by the end of the winter-rainfall area, which merges here into the more humid region of the George — Knysna forest with rain all the year round.

Xenopsylla sulcata Ingram, figs. 3, 10, 19 and 22

Xenopsylla sulcata Ingram, 1928, *Bull. ent. Res.* **18**: 374, figs. 4A, 6B, 7 (Citrusdal, C. P., from nest of *Tatera afer*); De Meillon, 1930, *Novit. zool.* **36**: 139-42, figs. 4, 6; Hopkins & Rothschild, 1953, Ill. Cat. Roths. Coll. Fleas **1**: 355, figs. 451, 453, 456, 465, pl. 43F; De Meillon, Davis & Hardy, 1961, Plague in Southern Africa **1**, The Siphonaptera: 135, pl. 25: 1-5.

Males of this species are easily distinguished from all others of this group by the strong development of the hump on t.I, the fact that the setae in the subapical row of st.VIII are numerous, long and strongly bent (fig. 10) and particularly by the shape of the median dorsal lobe of aedeagus which is not produced into a digitoid projection (fig. 3) and the shape of st.VIII (fig. 10). Females, on the other hand, cannot be separated from *hirsuta* and *lobengulai* with any certainty.



Figs. 13-16. Spermatheca and genital ducts of 13 and 14. *Xenopsylla hirsuta multisetosa* subsp. nov., 15; *X. davisi* de Meillon, paratype, and 16. *X. demeilloni* spec. nov., paratype.
Figs. 17-20. Tergum I of male of 17. *Xenopsylla* h. *hirsuta* Ingram (expanded); 18. *X. hirsuta multisetosa* subsp. nov., paratype; 19. *X. sulcata* Ingram, and 20. *X. demeilloni* spec. nov., holotype.

MALE: Occipital groove very deep, its greatest depth exceeding the greatest depth of eye. One to three small setae each side in the anterior row of t.I and nine to 12 longer, semi-erect ones in the posterior row, forming a dense group mounted onto a very conspicuous, triangular shaped, sclerotized lobe; apical margin of t.I with a deep mediodorsal indentation dividing the posterior half of the tergum into lateral lobes which are pointed and extensively fringed with minute false hairs (fig. 19). Antesensilial seta marginal, its pedestal very low. Apical margin of st.VIII produced subdorsally into a large triangular prominence, its subapical row of setae consisting of 10-13 very stout and long ones which are more or less evenly spaced and all of about equal length, the more ventral of them with a strong angular bend in about midlength (fig. 10). About five to six long and one to three smaller lateral setae on each side of st.VIII. Distal arm of st.IX slightly broader than in *hirsuta* and *lobengulai* and somewhat more tapering towards apex, but without any marked swelling. Median dorsal lobe of aedeagus (fig. 3) short, not forming a digitoid projection. Sclerites of the lateral lobes essentially of the pattern found in *hirsuta* reaching the apical margin of the lobes, but their distal edge more excavated and with a small stripe-like appendage more or less parallel to the anterodorsal margin. Aedeagal apodeme similar to *hirsuta* and *lobengulai*.

Females cannot be distinguished from *hirsuta* and *lobengulai* with certainty. On the average the type of spermatheca with a thicker hilla and a subglobular bulga (as shown in fig. 14 for *hirsuta*) occurs more frequently in *sulcata* than in *hirsuta*.

Specimens seen: 15♂♂ and 30♀♀ on slides from Citrusdal (Clanwilliam Distr.) and Nieuwoudstville area (Calvinia Distr.). Part of the material seems to belong to those series, from which the type specimens came (Citrusdal, September 1927). Specimens from Eendekuil, as indicated by de Meillon, *et al.* (1961: 137) could not be found in the collection.

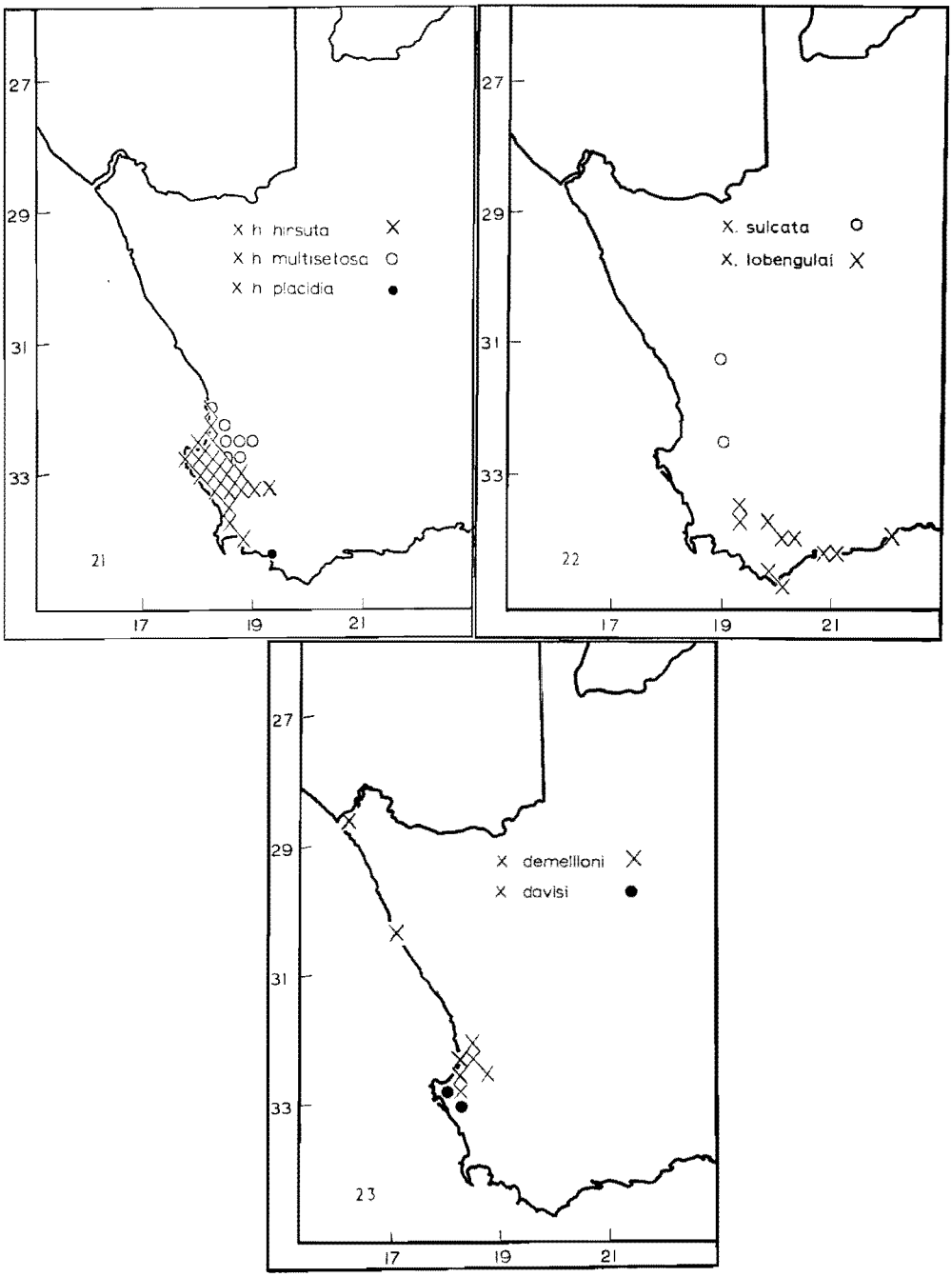
This seems to be a rare species, the most northern representative of the *hirsuta*-subgroup, found only in the more mountainous regions bordering the northwestern Karoo in the west. It is only known from *Tatera afra* (Gray).

THE *davisi*-SUBGROUP

MALE: Median dorsa lobe of aedeagus divided from the lateral lobes by a deep incision; sclerites of lateral lobes remote from apical margin of the lobes, leaving it membranous. Median lamella of aedeagal apodeme narrower than in the *hirsuta*-subgroup, rounded at the apex (*demeilloni*) or narrowed to a blunt dorso-apical point (*davisi*). Setae in the subapical row of st.VIII straight or at most slightly bent towards the apex, this row extending much farther upwards than any of the lateral setae of st.VIII. Long seta on t.IX not mounted on a definite pedestal but the posterior margin of the tergite forming an angle near its place of insertion. Apical margin of t.I smooth, without minute hair-like outgrowths (fig. 20).

EXPLANATION OF FIGURES

Figs. 21-23. Geographical distribution of the members of the *hirsuta*-group of *Xenopsylla*.



FEMALE: Basal sternum of abdomen without lateral setae, only the pair of ventral ones present. Duct of spermatheca short, especially the sclerotized portion of its wall which is slightly split on its distal end. Shape of spermatheca variable as in all members of the group, bulga usually subglobular in *davisi* and asymmetrical in *demeilloni*.

The main host of the two species of this subgroup is *Gerbillus paeba* A. Smith, though occasionally they may be found on *Tatera afra* (Gray) too. The distribution of these fleas (west coast of South Africa from about Saldanha Bay to the Southern Namib and Orange River mouth, i.e. largely outside the range of *Tatera afra*) also shows that they are not closely associated with this species. The available material is too scarce to say anything definite about the special relation between the two species but it seems possible that they are sympatric in the more southern part of the area mentioned above.

Xenopsylla davisi de Meillon, figs. 4, 11, 15 and 23

Xenopsylla davisi de Meillon, 1940, *Proc. R. ent. Soc. London (B)* **9**: 151, figs. 9-11 (Hopefield, C. P., from nest of *Gerbillus paeba*); Hopkins & Rothschild, 1953, Ill. Cat. Roths. Coll. Fleas **1**: 352, figs. 449, 458-460; De Meillon, Davis & Hardy, 1961, Plague in Southern Africa **1**, The Siphonaptera: 137, pl. 25: 6-9.

Males of this species may be distinguished from other members of the group by the shape of the aedeagal apodeme and the apex of phallosome (fig. 4) by the number and position of the stout, straight setae in the subapical row of st.VIII and by the distal arm of st. IX the base of which is swollen (fig. 11). Females can be separated from others by the absence of lateral setae on st.II and the shape of spermatheca and duct of bursa copulatrix (fig. 15).

MALE: Occipital groove shallow, its greatest depth about half the greatest depth of eye. T.I. with two to three setae each side in the anterior row and four longer, partially erect ones in the posterior row, the latter not placed on a separate hump or prominence; apical margin of t.I with a fairly deep mediodorsal indentation which reaches to about halfway between the posterior row of setae and the apical edge, the tergum otherwise similarly shaped to *demeilloni*. Antesensilial seta on a broad, rounded pedestal. Subapical row of st. VIII with nine to 12 straight, long and stout setae of about equal length divided into two groups, the more ventral of them consisting of five to eight (usually six) closely set setae which are directed upwards, in the more dorsal group the three to five (usually four) setae being wider spaced and directed downwards, thus crossing the tips of those of the ventral row. Five to six long and 0 to two small lateral setae each side on st.VIII. Distal arm of st. IX much expanded before the middle, tapering towards the rounded apex (fig. 11). Dorsal median lobe of aedeagus forming a very long, finger-like projection. Sclerites of the lateral lobes much widened towards the posteroventral end. Median lamella of the aedeagal apodeme much more slender than in other species of the *hirsuta* group, only about 1/6-1/8 as broad as long, its ventral margin turning up to form a blunt point at the dorso-apical angle (fig. 4).

FEMALE: Bulga of spermatheca usually subglobular. Duct of bursa copulatrix shorter than in the *hirsuta*-subgroup, with a short and thick crescentic sclerotization (fig. 15).

Specimens seen: 14♂♂, 6♀♀, from Hopefield (♂-holotype, 7♂- and 6♀-paratypes), Langebaan Road (♂-paratype and 2♂♂) and Velddrif (2♂♂).

This is obviously a rare species and its range of distribution may be far more extensive than the few records indicate. It was mainly found on *Gerbillus paeba* A. Smith, but occasionally on *Tatera afra* (Gray).

Xenopsylla demeilloni spec. nov., figs. 5, 12, 16, 20 and 23

Males of this species are characterized by the configuration of the apex of aedeagus (fig. 5) and by the relatively small number of straight, evenly spaced setae in the subapical row of st.VIII, the uppermost of them being much more dorsally placed than any of the lateral setae on this sternum (fig. 12). Females lack the lateral setae on st.II (found in the *hirsuta*-subgroup) and the heavy sclerotization in the wall of the duct of bursa copulatrix (found in *davisi*) (fig. 16), but some atypically built specimens are difficult to distinguished from *davisi* or *hirsuta*.

MALE: Occipital groove deeper than in *davisi*, its greatest depth often subequal to greatest depth of eye. Setae on t.I much as in *davisi*, two to three small in the anterior row and three to four longer, partially erect ones in the posterior row, not placed on a prominence; apical margin of t.I only slightly emarginated middorsally (fig. 20). Antesensilial seta marginal, at most mounted on an inconspicuous pedestal. St.VIII with four to seven, usually five moderately long and stout setae in the subapical row which are more or less evenly spaced and all of about equal length, the more dorsal two or three of them directed slightly downwards. About three to five long and two to three smaller setae laterally on st.VIII. Distal arm of st.IX of about equal width throughout, without any sub-basal swelling. Median dorsal lobe of aedeagus forming a digitoid projection, which is not, however, quite as long as in *davisi*. Sclerites of the lateral lobes of about equal width throughout, of the shape of a shallow S. Median lamella of aedeagal apodeme as in all members of the *hirsuta*-group except *davisi*, but usually less expanded apically.

FEMALE: Without lateral setae on the basal sternum of abdomen. Bulga of spermatheca asymmetrical or subglobular, often similar to *hirsuta*. Sclerotization of the wall of duct of bursa copulatrix short as in *davisi*, but not thickened and nearly straight (fig. 16).

Four females (three from Bergrivier, Malmesbury Distr., off burrow of *Gerbillus paeba* and one from the body of *Tatera afra* at Farm Teliasfontein, P.O. Het Kruis, Piketberg Distr.) cannot be placed here with full certainy. They bear a lateral seta on one side of the basal sternum (in one case on both sides) but have the duct of bursa copulatrix as in *demeilloni*.

♂- Holotype: Het Kruis, Graafwater Section (C.P.) from *Gerbillus paeba* (burrow), 23. II. 1943, C.V. Muller; 46♂- and 60♀- paratypes: from the same lo-

cality as the holotype and from other places near Het Kruis, from Bergrivier, Sandberg, Graafwater (Clanwilliam Distr.), Wallekraal and Alexander Bay (Namaqualand). Additionally 10♂♂ and 14♀♀ in alcohol were seen.

On the distribution map of *X. h. hirsuta* in de Meillon, *et al.* (1961, map 19c) some of the more northern records actually refer to *demeilloni*.

This is the more common of the two species of the *davisi*-subgroup. It is distributed along the whole west coast of South Africa from Bergrivier in the south to the Orange River mouth in the north. It was never found in the same places as *davisi*, but at least Bergrivier seems to be in the range of the latter species and it is therefore possible that both can occur together. The main host is *Gerbillus paeba* A. Smith. Several specimens were taken from *Tatera afra* (Gray) and one record is from burrows of *Desmodillus auricularis* (A. Smith).

This species is named in honour of Dr Botha de Meillon, who, with his excellent work on South African fleas and his assembling of a fine collection of these insects at the South African Institute for Medical Research prepared a firm foundation for all future studies and thus made this paper possible.

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REFERENCES

DE MEILLON, B., DAVIS, D. H. S. and HARDY, F., 1961. Plague in Southern Africa, vol. I. The Siphonaptera. Government Printer, Pretoria, VIII and 280 pp., 36 maps.

HOPKINS, G. H. E. and ROTHSCHILD, M., 1953. An Illustrated Catalogue of The Rothschild Collection of Fleas, vol. I. British Museum, London, XVI and 361 pp., 1 map, 45 plates.